

somewhat in detail, he adds, that after this inquiry into the principal circumstances connected with the treatment of stone, by lithotomy and lithotrity; in which he has attempted to place side by side, their respective dangers and advantages by an appeal to facts, and thus to establish the degree of estimation in which each ought to be holden in practice, his conviction is, that wherever lithotrity can be employed, lithotomy should never be thought of.

“Whether we look at the structure of the parts concerned, at the nature of the disease, or at the results furnished by experience, we are led to the same conclusion. Every thing conspires to establish the superiority of lithotrity, and to place it at an almost immeasurable distance above lithotomy. A wound in the bladder, of itself, endangers life more or less, even when uncomplicated by the serious accidents we have had occasion to notice, and every one of which may separately cause death. On the other hand, the objections that can be made to lithotrity, however numerous, are but as dust in the balance, when weighed with those which belong to the other plan; and were we to attempt to express, in a few words, the verdict imperatively called for, by the testimony of reason and experience, that verdict would be—the abolition of lithotomy.”

Dr. King concludes his work with some useful practical observations on the treatment of calculi of great magnitude and density, and terminates his work with a chapter on the treatment of stone in the female, and one containing general remarks on the medical treatment of calculous disorders. In closing this notice, we must express the high opinion we entertain of the merits of the volume before us, and the hope that every surgeon in this country will, before undertaking the treatment of stone in the bladder, become familiar with the facts and arguments adduced by Dr. King in favour of lithotrity. L.

ART. XVI. *An Essay on the Operation of Poisonous Agents upon the living Body*. By THOMAS ADDISON, M. D. Assistant Physician to Guy's Hospital; and JOHN MORGAN, F. L. S. Surgeon to Guy's Hospital. London, pp. 91, 8vo.

THE experiments detailed in the interesting volume before us, were undertaken without any intention of publication. The results of their investigations have, however, otherwise determined the authors; who discovered—

“In those results, that which is well worthy the attention of the medical philosopher; and which, they are willing to hope, is calculated to throw addi-

tional light upon a subject which must ever deeply concern the physiological, the pathological, and therapeutical student."

With the view to render the object and bearing of their work clear and intelligible, the authors have premised some general remarks on the nature and influence of those agents that are usually included under the term of poisons. The definition they give of this term, does not differ materially from that adopted by toxicological writers; it is as follows:—Any substance which, taken in a small quantity into the alimentary canal, or introduced into a wound, or even applied to the unbroken and healthy surface of the body, is capable of producing effects deleterious or fatal to animal life. From this, it will be perceived, that every powerful medicine may be considered as a poisonous agent, which is only rendered beneficial as a remedy for disease by the diminished quantity in which it is administered, and consequently by the diminished influence it exerts upon the system.

"The distinction, therefore, between our most active and useful medicines and poisons, is an arbitrary one; every powerful medicine being, strictly speaking, a poison, when given in sufficient quantity; and most of our poisons being useful and powerful remedies for disease, when administered in regulated quantities. Every substance, then, whether solid, fluid, or ærial, which produces morbid action in the system, is, strictly speaking, a poison: the term, however, is commonly applied to those only of the most active kind."

It is very judiciously remarked, that the immediate impression stamped upon the living powers of the system by poisons, is a matter which must probably for ever remain involved in impenetrable darkness. Nor should this be a subject of astonishment, since such a knowledge would imply a knowledge of the proximate or first causes of vital phenomena. On the other hand, the local and visible consequences resulting from the action of poisons are so readily ascertained by experiment and observation, and are so generally known, that they have rarely afforded ground for discussion or controversy. To neither of these questions, therefore, do our authors desire to direct the attention of their readers. Their object is to investigate another and more interesting point connected with the operation of the agents in question, and which continues to be disputed and obscure. We allude to the medium through which poisonous substances convey a morbid impression to the system.

They remark, that before any sensible effect can be made upon the general system by the application of a poison, it is essentially necessary that an impression should be carried to the brain. The question then is, whether the actual contact of the poison with this organ is necessary for its operation, or whether sympathy between the

nerves of the poisoned part and the brain is sufficient to establish a communication, through which the latter may become affected. In order that the first of these effects—actual contact of the poison with the brain, should be obtained, it is necessary that the substance should be carried to that organ from the poisoned part through the circulation, either by the medium of the veins, or of the absorbent vessels; that it should be conveyed into the blood, either indirectly through the absorbents, or directly by entering the veins of the poisoned surface. In the latter case, the poison is said to influence the brain by the medium of venous absorption. This view of the subject is advocated by a large number of physiologists, and is supposed to be confirmed by the results of certain experiments, to which we shall advert presently, as well as by the detection of some poisonous substances in the blood, or the more intense vitiation of that fluid, in a great number of cases of diseases, through the agency of such substances on the system. But although very generally received, this explanation is not viewed as satisfactory by every physiologist, and there are not wanting those who, rejecting the idea of a necessary passage of the poisonous agent along with the blood, to the brain, support the theory of nervous communication between the part which has received the first impression of the poison, and the cerebral organ, and assert that the constitutional disturbance arising from the application of a local agent, is adequately accounted for by the connexion or sympathy naturally existing between the extremities of the poisoned nerves and the sensorium.

This, as our authors remark, is one of the most important questions to which a physiologist can direct his attention; for it is not confined to the phenomena produced by the action of poisons, but “involves a theory which has reference to every morbid action that takes place in a living animal, from the operation of local irritation upon the functions of the brain and nervous system.” That this is the case, they argue from the circumstance, that—

“Whether constitutional disturbance shall be produced by the imperceptible operation of noxious miasmata, or whether it shall arise from a visible and local cause, as in the inoculation of small-pox, syphilis, or hydrophobia, still we find no distinct line of demarcation separating the essential characters of what is strictly called a poison, from those produced by more general and more ordinary causes of disease.”

This parallel is founded on the circumstance, that no distinction can be established, which has reference to the periods elapsing between the application of a poison, or of an ordinary cause of disease, and the appearance of the effects produced by the brain, as we find

in both an endless variety in this respect; and that there exists a perfect similarity between the sensible consequences of poisons and those of other morbid agents. Our authors consider, that all fair analogy forbids the conclusion, that a poison, or an ordinary cause of disease shall, at one time, produce constitutional disturbance through the medium of one system of organs, and at another time through the medium of different systems; that under certain circumstances a poison, or any other cause of disease, shall affect the functions of the brain and nervous system at one time through the medium of the nerves, at another time by the circulation, and at another by the action of the absorbent vessels.

"It is contrary to all fair analogy, they say, to suppose, that any variety observed in the effect of a local agent, can essentially depend upon the medium by which it is carried into the system."

So far from feeling disposed to adhere to such a view, our authors very correctly believe that every organ in the living system is destined to perform its proper functions; that as far as our physiological researches have yet extended, we are justified in assuming, that no two organs in the human body are capable of performing the same function, and that two functions cannot be performed by the same organ.

In reference to the subject in question, they maintain, for instance, that the sympathy between the brain and stomach cannot be said to be conveyed along the eighth pair of nerves at one time, and by the circulating system at another: that when vomiting occurs as a consequence of concussion of the brain, it is occasioned by nervous sympathy; and that when morbid sensibility of the brain is produced by derangement in the digestive organs, that morbid sympathy is the result of absorption; and they deny that there are two roads between these two organs, by which sympathy is established; the one leading from the head to the stomach, and the other from the stomach to the head.

"Since then," they say, "the various phenomena resulting from the effects of poisons upon the system are too intimately connected with those produced by other causes of morbid excitement, to admit of any distinct line of separation; since we are led by analogy to believe, that the medium by which an impression is made upon the brain and nervous system, is the same in both cases, it must be manifest that the question, which has arisen amongst physiologists in every age, respecting the medium through which poisons influence the general system, is one that has reference also to the mode in which all morbid phenomena are produced in the living system; and therefore it involves a theory of the highest importance to the physiologist, to the physician, and to the surgeon; a theory, indeed, intimately and inseparably connected with every branch of science which has for its object the elucidation of those phenomena produced by local agents of every description upon the living body."

Messrs. Addison and Morgan next examine and criticise the opinions of former writers in relation to the medium through which poisons produce their effects upon the body; premising, 1, that although much valuable information respecting the morbid appearances which indicate the effects of different poisons may be found in the works of FONTANA and others; as well as in the later productions of ORFILA; yet these writers have left the question of the medium of communication as they found it, involved in doubt and obscurity; and, 2, that modern physiologists have endeavoured to establish the theory which would associate the operation of almost every poison with the process of venous absorption, while, however, they admit, that some of these poisonous agents destroy life so instantaneously, that they must be supposed to operate immediately upon the nerves. They commence with the experiments of Mr. BRODIE, the results of which, that distinguished physiologist and surgeon has recorded in the *Philosophical Transactions of London*. The effects obtained in these experiments by the essential oil of bitter almonds applied upon the tongue, or injected into the rectum of cats, were, as some of our readers doubtless know already, referred by Mr. Brodie to the action of this substance upon the brain, through the medium of the nerves. Without pronouncing for the present, on the correctness of this theory, our authors protest against the train of reasoning by which it has, in this instance, been supported; for it is assumed by Mr. Brodie, that the susceptibility of any part of the human body to a morbid impression may be correctly estimated by a dissection of its nerves, and that in proportion to the greater size and number of these will be the rapidity with which such morbid impression is conveyed to the brain. They also dispute the assumption, that the extreme irritability of the nerves of the tongue under one proper cause of excitement, is to be considered as a proof of their increased excitability to action under the impression of a morbid agent; both of which suppositions would involve a theory respecting the multiplied functions of a single nerve, which is not only unsupported by analogical reasoning, but is in many instances directly contradicted by fact.

“By the functions of a nerve we of course mean the functions performed by its extreme branches, as unconnected with the effect produced upon the brain by a local stimulus applied to its main trunk; for it is well known, that the *trunk* of a nerve may, under the action of very different stimuli, convey a similar impression to the brain, the effect of which is recognised under the general term of *sensation*, whilst its *extreme terminations* only receive and convey to the sensorium those peculiar impressions, for the production of which the organ was first called into existence; and, as it is proved that the same stimulus applied to the extremities of a nerve, which is highly susceptible of its influence,

and which consequently produces an immediate and powerful effect upon the system, may be applied without producing any sensible effect upon the extreme branches of another nerve, which, from the operation of a different exciting cause, may evince an equal degree of excitability; as, in short, it has been shown that the functions of a nerve cannot be determined by its comparative sensibility, we are at a loss to conjecture what has induced Mr. Brodie to support an opinion, in which he is neither borne out by fair reasoning nor by sound analogy."

To establish the correctness of their opinion, our authors resorted to the following experiment. The spinal marrow of a half-grown rabbit was divided, and the leg inoculated with Prussic acid. The animal died in three minutes after the introduction of the poison,—this being the usual period of time in which that poison was found to operate upon these animals under common circumstances, when introduced into the same part. Now, they remark, if the impression produced upon the brain by the application of Prussic acid to a distant part be the consequence of its action on nerves of sensation and voluntary motion, as Mr. Brodie supposes to be the case, it would be difficult to explain the result of the above experiment. At the same time they affirm, that the theory of venous absorption cannot any better account for the instantaneous operation of the poison in the same example.

Passing next to the effects produced by the application of poisons to wounded surfaces, and to the manner in which, under such circumstances, these substances act upon the brain, our authors remark, that having found, in some experiments with ticunas, that the latter produced its effects in the usual time, even when the thoracic duct had been tied, or the axillary plexus divided, Mr. Brodie concluded, that it had acted upon the brain by entering the circulation through the divided vessels. Mr. Brodie endeavoured to support this view by the following experiment. A tape half an inch wide was tied round the thigh of a rabbit, excluding the sciatic nerve, and although the leg was wounded and poisoned with ticunas, yet no sensible effect was produced at the end of an hour from the operation. After this interval of time had elapsed, the ligature was removed, and in twenty minutes the animal was found motionless and insensible. Mr. Brodie further considers, that the poison does not produce its effects until it enters the substance of the brain, along with the blood in which it is dissolved; and from analogy infers, that other poisons may affect the system in a similar manner. In drawing this conclusion Mr. Brodie again assumes, that the nerves of sensation and volition are the organs by which, in case of nervous communication, a morbid impression is carried into the system; a theory which, had he

renewed his experiment, he would have been at once convinced was, according to his own hypothesis, founded in error; for if, instead of applying the poison of woorara to a limb, around which (excluding the principal nerve,) a tight ligature had been applied; if instead of using that poison he had applied Prussic acid, he would, according to our authors, have met with nearly the same result as was obtained by them on a repetition of the experiment. They conclude that Mr. Brodie's opinion respecting the mode of action of Prussic acid might be opposed to his views relative to the operation of the other substance; since the same argument by which the theory of venous absorption is supported in reference to the poison of woorara, holds equally good in this case as applied to the poison of Prussic acid.

Messrs. Addison and Morgan are of opinion that the kind of venous absorption for which Mr. Brodie has contended—an absorption into the venous circulation through the mouth of a divided vessel, is extremely problematical, if not physically impossible.

“When a vein is divided, it is well known, that unless some branch be interposed between the truncated extremity and the next valve in its course towards the heart, unless the current of blood be driven through the cut extremity of the tube by collateral branches, we find that the sides of the vessel as far as the next valvular interruption will collapse and remain inactive; supposing the poison, then, to enter this flaccid tube, it is completely prevented from mixing with the circulating blood which fills the vessel above the valve by the pressure made by that circulating blood upon the opposite side of the valve, and consequently, under such circumstances, unless it can be proved that a poison has the property of propelling itself, it requires no argument to prove that the substance, instead of passing into the circulation, will remain stationary in that part of the vessel through which no circulation is carried on. If, on the other hand, circulation be carried on by collateral branches through that part of the tube which lies between the nearest valve and the mouth of the divided vein, the effect will be still more unfavourable to Mr. Brodie's hypothesis; for the circulation in that part of the vessel will be revived, and consequently, instead of being carried towards the heart, the poison will be washed out of the wound; in either case, therefore, it seems highly improbable that the poison can pass through the circulation to the brain by the medium of a divided vein. We do not dispute that foreign substances may be taken into the system by means of absorption; but we very much question the possibility of that absorption taking place, as Mr. Brodie has supposed it does, through the truncated extremity of a divided vessel.”

In reference to the opinion and experiments of Mr. Magendie on the subject in question, our authors remark that if his theory had related solely to the possibility of a poison entering the circulation, and producing, in that way, an impression upon the brain and nervous system, no possible objection could have been offered to the proof

which his experiments would have furnished; but that when they find, that the object of these experiments, relative to operation of poisons, has been to establish the fact, that the admixture of *all poisons* with the blood, which circulates through the veins of the poisoned part, is *absolutely* necessary to their operation, they feel called upon to urge, in the strongest possible manner, their objections both to the theory and to the slender foundation upon which it has been supported. They accordingly examine and comment upon almost every point of the experiments of the French physiologists—experiments which must be familiar to most of our readers. They contend, that the preliminary step of the operation—the administering of opium to diminish the sufferings of the animal was calculated to render all further investigations upon the body of the latter altogether nugatory; because when a sufficient quantity of opium is administered to produce the effect in question, this effect must interfere so materially with the action of any other specific agent, as to render it almost impossible, in many cases, to determine, by external evidence, whether, in the event of a fatal termination, the animal has been destroyed by the opium or by the other poison, or by the combined action of the two. In regard to the remaining steps of the operation they contend that the blood which circulated from the poisoned limb, through the femoral vein, must have brought the poison, with which it was mixed, into contact with the inner coats of the veins of the body, and that consequently, a highly irritable and widely extended surface of membrane was exposed to the action of that poison long before it could have reached the brain. They further object to M. M.'s theory on the ground that when a ligature is applied around the femoral vein of any animal, and the lower extremity of that animal on the same side is inoculated with Upas, the poison will exert its ordinary influence upon the system, which ought not to be the case, were the poison really *carried* to the brain; since the quantity thus carried would be very small; and again, that had the poison been carried to that organ, the circulation in the limb and the effects of the poison must have been retarded, which, however, was not the case. These objections they add will not apply to the theory of nervous communication, for the following reasons:

“That, as the nerves of the interior coats of veins are supposed by the supporters of that theory to receive the first impression from poison which circulates through the cavity of the vessel, and as these nerves are proved by daily observation to possess a high degree of morbid susceptibility; as, moreover, it has been proved by Mr. Magendie's experiments, according to his *own* showing, that the poison must necessarily pass through the largest veins in the body in its course through the circulation, it may reasonably be inferred, that any



difference in time, which ought, according to the other theory, to have occurred between inoculation and effect, is prevented by the unimpaired functions of those nerves which supply the inner coats of the veins above the amputated limb, as these nerves must, of course, convey, in the usual time, the impression which the circulating poison produces upon their extremities; and as the poison is manifestly brought through the severed limb to the trunk before it can possibly affect the system, it must still remain a point at issue, whether the brain itself, or the nerves of the veins, receive its first impression."

In reference to the conclusions which Dr. Barry has drawn from his experiments, our authors are of opinion, that the soft structures of the surface of the body, which are covered by an exhausted cupping-glass, must necessarily, from the pressure of the edges of that glass, be deprived, for a time, of all connexion, either nervous or vascular, with the surrounding parts; that the nerves must be partially or altogether paralyzed by compression of their trunks, and that, from the same cause, all circulation through the veins and arteries situated within the area of the glass must cease; that the rarefaction of the air within the glass being still further increased by means of a small pump attached to it, the fluids contained in the divided extremities of the vessels are forced into the vacuum, and with these fluids, of course, either a part or the whole of the poison which had been introduced; and that in such a condition of parts, it is manifest, that the compression on the one hand, and the removal of the poison from the wound on the other, will explain in a satisfactory manner the result of the experiment, as well to the advocate of nervous communication, as to the supporter of the theory of venous absorption.

From a survey of what precedes, as well as from the results of their own experiments; and after once more assuming that it is unphilosophical to admit a twofold mode of operation of poisons; and taking into consideration the effects of nervous irritation in producing disease under circumstances when the absorption of a morbid matter cannot be presumed to have occurred, our authors arrive at the conclusion—

*"That all poisonous agents produce their specific effects upon the brain and general system through the sentient extremities of nerves, and through the sentient extremities of nerves only; and that when introduced into the current of the circulation in any way, their effects result from the impression made upon the sensible structure of the blood-vessels, and not from their direct application to the brain itself."*

The experiments detailed by our authors were instituted for the purpose of showing the extreme susceptibility of the inner coat of a vein when exposed to the action of a poison; 2d, that the almost instant-

neous effect of a poison when circulating through a blood-vessel is rather to be attributed to its operation upon the sensible structure of the vessel itself than to its conveyance by such means to the brain; and 5d, of ascertaining whether in all cases the poison circulates in the blood and acts in that way on the nervous system of the animal.

The first of these points was established by placing, by means of small tubes inserted within the cut extremities of one of the jugular veins of a dog, small portions of woorara—the vessel being previously secured by ligatures above and below the place of division; and by allowing the poison, at a given moment, to mix with the blood, and to enter with it the torrent of the circulation. In these cases the effect of the poison was obtained in forty-five seconds. In another case, in which the same agent was placed *above* a permanent ligature and inclosed in a cylinder of quill, the effect was obtained in one hundred and eight seconds.

“The poison which was used in these two cases has never been known in dogs to produce a sensible effect upon the system, in cases of its insertion into superficial wounds of the body, in less than six minutes, and respiration usually has ceased in from a quarter of an hour to twenty-five minutes.”

To establish the second point, the poison was introduced into the carotid artery of a fox-hound, and carried instantly into the brain. In the case of venous absorption and cerebral contact instant death of the animal ought to have been the result. But—

“It was found, that the time which elapsed between the removal of the temporary ligatures and the fatal effects of the poison upon the body, was nearly the same in this as in the former case of its introduction into the jugular vein, for the animal dropped in forty-five seconds, and ceased to respire in two minutes.”

In another case the femoral artery was selected as the seat of a similar operation. As the poison, in this experiment, was carried downwards, it could not possibly find access to the brain until it had passed through the ramifications of the lower extremities, the capillaries and veins, to the heart, lungs, &c. all of which required considerable time. Yet notwithstanding these circumstances, the animal dropped in convulsions in the short space of forty seconds—even more rapidly than in the case in which the poison was sent directly to the brain through the medium of the carotid. The results of these experiments, which our authors consider as completely opposed to the theory which would attribute the action of a poison upon the system solely to its contact with the substance of the brain, are, they think, strengthened by other experiments they detail, in which the mere ap-

plication of a poisonous agent to the wounded substance of the cerebral organ was unattended by those immediate and fatal effects which might reasonably be expected by the advocates of the theory in question.

To settle the third point—whether poisons circulate with the blood through the brain, Messrs. Addison and Morgan resorted to the following experiment. Two dogs were held face to face—the carotids of each were cut, and the lower extremity of one artery was made to communicate, by means of a brass tube, with the upper extremity of the carotid of the other dog. By this arrangement the blood of one of these animals was forced to pass into the body of the other. Upon introducing the poison of *nux vomica* into the back of the animal from whose carotid the blood was passing into the vessel of the other, it was found, that although the usual violent effect was produced in the inoculated dog, and although that effect continued for the space of fourteen minutes, during which a free circulation was maintained between them in the manner already mentioned, yet not the slightest indications of the action of the poison upon the system of the other animal could be observed. In another experiment the jugular veins were substituted for the arteries. The animal contributing blood to the other was inoculated in the side of the face, and in the usual time exhibited the customary symptoms, which continued during seven minutes. But although the circulation was freely kept up through the artificially connected jugulars, the other dog never showed the slightest symptoms of being poisoned. Finally, by means of a double tube, the authors were enabled, in a subsequent experiment, to establish a complete double circulation between the carotids of a poisoned and of a sound dog. But in this experiment the results were similar to those obtained in the foregoing.

The authors terminate by stating that so far as they are competent to judge, they think they are borne out in the conclusion, that all poisons, and perhaps all agents influence the brain and general system through an impression made upon the sentient extremities of the nerves, and not by absorption and direct application to the brain; adding, that if the experiments detailed in this essay are not satisfactory to their readers, they at least indulge the hope, that what has been advanced may lead to the discovery of more satisfactory and more conclusive evidence than has yet been adduced on this truly important question; a question, indeed, of the deepest interest, not as a mere matter of curiosity, but as involving the elucidation of many of the most prominent, and at present, the most mysterious phenomena of a living body.

L.